Public Health Briefs

Fifteen-Year Follow-Up of Smoking Prevention Effects in the North Karelia Youth Project

Erkki Vartiainen, MD, PhD, Meri Paavola, MSc, Alfred McAlister, PhD, and Pekka Puska, MD, PhD

ABSTRACT

Objectives. This study evaluated the long-term effects of a school- and community-based smoking prevention program in Finland.

Methods. Four intervention schools from North Karelia and two control schools from another province were chosen for the evaluation. Students who received the intervention were taught to resist social pressures to smoke. The program began in 1978 with seventh-grade students and ran through 1980, with a 15-year follow-up. In North Karelia, a community-based smoking cessation program for adults was also carried out.

Results. Mean lifetime cigarette consumption was 22% lower among program subjects than among control subjects. Smoking and prevalence were lower up to the age of 21.

Conclusions. Long-term smoking prevention effects can be achieved if a school-based program using a social influence model is combined with community and mass media interventions. (*Am J Public Health.* 1998;88:81–85)

Introduction

In this paper we describe the results of a 15-year follow-up of a school- and community-based smoking prevention program in the province of North Karelia, Finland.

In the late 1970s, information-oriented prevention programs in schools had no apparent effect on smoking behavior[1]; prevention programs based on broader theories of behavioral change followed.[2] Most used psychological inoculation techniques and behavioral rehearsal, often conducted by peer leaders, to strengthen attitudes and skills that aid in resisting pressures toward tobacco use during adolescence.

Immediate short-term results generally indicated 30% to 50% fewer smokers in the program groups than in control groups.[3–6] Long-term follow-up results, however, are inconsistent. The immediate positive short-term effect on smoking disappeared soon after the intervention in four studies[7–10] but lasted at least a few years in four others. The communitywide Minnesota Heart Health Program reported positive long-term results 2 years after the end of the school interventions.[11] Concurrent populationwide interventions were sustained over a 5-year period. At the 6-year follow-up in grade 12, 14.6% of students in the intervention schools and 24.1% in the control schools were smokers. A randomized trial of the Life Skills Training Program indicated positive effects in a 5-year follow-up to grade 12, 3 years after the program ended.[12] In Vermont, the effects of the School and Mass Media Project persisted 2 years after the intervention in a 6-year follow-up.[13] In the North Karelia Youth Project, one of the first studies to evaluate these behavioral strategies, positive results persisted at 4 years and 8 years postintervention.[14–17]

Methods

Beginning in 1978, seventh-grade students (aged 12 to 13 years) in North Karelia were exposed to a smoking prevention program over a period of 2 years. The program used a social influence approach.[2] Students were taught about social pressures to smoke, exerted by peers, adults, and mass media, and were trained by demonstration and role playing to deal with them. The short-term and long-term health hazards of smoking were also discussed during the program.

In 2 schools, health educators and trained peer leaders led 10 sessions in all: 3 in the seventh grade, 5 in the eighth grade, and 2 in the ninth grade. In other schools, teachers trained to disseminate new curricula led five sessions in all in the eighth grade as part of a program to reduce cardiovascular risk factors among adolescents. Details have been published elsewhere.[18] The North Karelia Project, a community-based cardiovascular disease prevention program for adults, was started in 1972 in the same area.[19] During the years of the school-based smoking prevention program, an intense program of mass communication and community organization was also carried out to promote smoking cessation among adults.[20]

For the evaluation of the program, three pairs of schools were chosen. In each

Erkki Vartiainen, Meri Paavola, and Pekka Puska are with the Department of Epidemiology and Health Promotion, National Public Health Institute, Helsinki, Finland. Alfred McAlister is with the University of Texas School of Public Health, Houston.

Requests for reprints should be sent to Erkki Vartiainen, MD, PhD, National Public Health Institute, Mannerheimintie 166, FIN-00300 Helsinki, Finland. E-mail: erkki.vartiainen@ktl.fi.

This paper was accepted October 3, 1997.

TABLE 1—Participation Rate in Surveys from 1978 to 1993, by Intervention Condition: North Karelia Youth Project

	Health Educator–Led Program (n = 314), %	Teacher-Led Program (n = 299), %	Control Group (n = 290), %	Total (n = 903), %
At school, fall 1978 (7th graders; students' questionnaire, risk factor survey, parents' questionnaire)	99	99	100	99
At school, fall 1980 (9th graders; students' questionnaire, risk factor survey, parents' questionnaire)	94	95	95	94
At school, spring 1981 (9th graders; students' questionnaire)	80	84	86	83
By mail, fall 1982 (questionnaire)	85	87	89	87
By mail, fall 1986 (questionnaire)	74	67	78	73
In health center, fall 1993 (questionnaire filled in at home, risk factor survey)	66	70	77	71

pair, one school was in the capital of the province and the other was in a small village. The first pair of North Karelia schools selected had received the program conducted by health educators, and the second pair had received the teacher-led program. The third pair of schools, for the control condition, were selected from a neighboring province. Schools were paired on the following community variables: size of population, number of junior high schools and number of students in the school, degree of urbanization, and age structure.

School surveys conducted in fall 1978 and 1980 included a self-administered questionnaire and a survey for cardiovascular risk factors. The questionnaire was readministered in the schools in spring 1981 and by mail in fall 1982 and 1986. Finally, in 1993 subjects filled in the questionnaire at home and a trained project nurse carried out a cardiovascular risk factor survey in a local health center.

Participation rates are presented by intervention condition in Table 1. The Population Register Centre, on the basis of social security numbers, provided addresses after the subjects had left school. Selective loss did not introduce systematic bias into the comparisons. Losses did not differ between the two intervention programs in the following variables: smoking in 1978 or 1980, parents' occupation or education, leisure-time physical activity, hobbies, serum cholesterol, blood pressure, or body mass index.

In all the surveys, self-reported smoking was measured by the following question: "Do you smoke now?" Possible responses were 1 (not at all), 2 (less than once a month), 3 (once or twice a month), 4 (once or twice a week), and 5 (daily). Daily smokers were asked to estimate the number

TABLE 2—Percentages of Smokers at Baseline (1978) and in Follow-Up Surveys, by Smoking Level in Three Groups: North Karelia Youth Project

	Health Educator–Led Program	Teacher–Led Program	Control Schools	$P(\chi^2)$[a]
1978 (Age 13)				
All smokers	15.0	13.2	8.4	.047
At least 1–2 times/mo	9.6	6.4	4.7	.073
At least 1–2 times/wk	5.8	4.6	2.2	.095
Daily	3.1	2.5	1.1	.266
n	293	280	274	
1980 (Age 15)				
All smokers	25.3	24.5	34.8	.011
At least 1–2 times/mo	20.5	19.1	29.3	.008
At least 1–2 times/wk	18.8	16.3	26.4	.009
Daily	15.4	10.3	21.2	.003
n	293	282	272	
1981 (Age 16)				
All smokers	30.0	30.0	40.7	.014
At least 1–2 times/mo	22.8	22.8	33.9	.005
At least 1–2 times/wk	19.2	20.4	29.8	.009
Daily	17.2	17.2	23.8	.010
n	250	250	248	
1982 (Age 17)				
All smokers	33.6	30.7	44.4	.003
At least 1–2 times/mo	26.5	26.1	37.8	.004
At least 1–2 times/wk	23.9	22.6	32.0	.029
Daily	20.1	18.4	28.2	.016
n	268	261	259	
1986 (Age 21)				
All smokers	42.2	35.2	50.0	.008
At least 1-2 times/mo	39.2	30.2	43.4	.173
At least 1-2 times/wk	34.9	26.1	38.5	.022
Daily	31.0	22.6	33.6	.035
n	232	19.9	226	
1993 (Age 28)				
All smokers	34.6	34.3	42.8	.115
At least 1–2 times/mo	33.2	31.0	37.4	.356
At least 1–2 times/wk	29.8	28.1	31.1	.793
Daily	32.5	32.8	34.7	.713
n	208	210	222	

[a]Chi-square test across the three groups.

of cigarettes they usually consumed each day.

Lifetime cigarette consumption (reported in packs of 20 cigarettes for all students participating in the last survey in 1993) was obtained by multiplying the number of cigarettes per day by the number of days between surveys. Each survey was assigned half of the intervals before or after the adjoining surveys. Missing data points in different follow-up surveys were replaced by smoking status in the preceding survey. An analysis that ignored missing data and another that used only data for subjects with no missing data yielded similar results.

In the analyses, both individual and school were used as the unit of analysis. At the individual level, the chi-square test was used for proportions comparing the intervention programs at each follow- up point, using the cohort members available at that time. The test was done across the three intervention conditions, unless otherwise stated in the text. Analyses of variance were used for lifetime cigarette consumption, and analyses of variance were used on the school level to confirm the individual-level analyses.

TABLE 3—Percentages of Smokers in Different Follow-Up Surveys, by Smoking Level among the Nonsmokers at Baseline: North Karelia Youth Project

	Direct Program	Teacher-Led Program	Control Schools	$P(\chi^2)$[a]
1980 (Age 15)				
All smokers	18.5	18.6	29.2	.004
At least 1–2 times/mo	13.3	13.6	23.6	.002
At least 1–2 times/wk	12.1	12.4	21.6	.004
Daily	9.7	7.4	18.0	.001
n	248	242	250	
1981 (Age 16)				
All smokers	23.5	22.2	37.7	.000
At least 1–2 times/mo	16.0	16.2	30.7	.000
At least 1–2 times/wk	13.1	14.8	26.4	.001
Daily	11.7	12.5	21.6	.005
n	213	216	231	
1982 (Age 17)				
All smokers	28.3	25.8	41.2	.001
At least 1–2 times/mo	21.3	21.3	34.5	.001
At least 1–2 times/wk	18.3	17.3	28.6	.005
Daily	15.2	13.8	25.2	.002
n	230	225	238	
1986 (Age 21)				
All smokers	37.5	30.1	46.9	.003
At least 1–2 times/mo	34.0	26.0	40.6	.012
At least 1–2 times/wk	29.5	21.4	35.3	.012
Daily	26.5	17.9	30.9	.140
n	200	173	207	
1993 (Age 28)				
All smokers	30.8	29.3	41.2	.026
At least 1–2 times/mo	29.7	25.4	35.3	.106
At least 1–2 times/wk	26.4	22.7	28.9	.374
Daily	21.4	22.1	26.5	.442
n	182	181	204	

[a]Chi square test across the three groups.

Results

Participation was sustained at high levels, with 71% of the cohort retained after 15 years. Immediately after completion of the program in 1980, one-third fewer students reported smoking at least once a month in both intervention groups than in the control group. Six months and 2 years later, results were much the same. At 8-years, a preventive effect persisted only in the schools with teacher-led programs. At 15 years, differences between program and control schools were no longer statistically significant (Table 2).

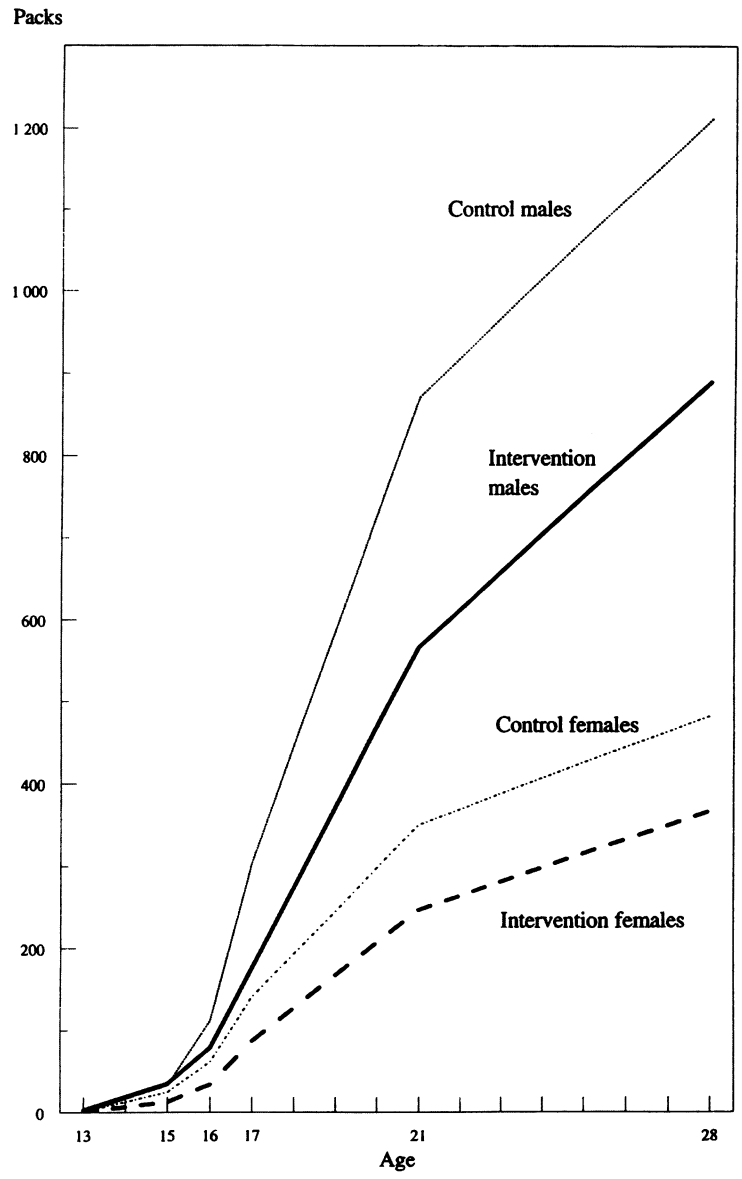
Among the nonsmokers at baseline who were followed up to age 21, at any given level of smoking significantly fewer students in the intervention schools than in the control schools took up smoking (Table 3). At age 28, the difference remained statistically significant (30.0% vs 41.2%). Within categories of regular smokers, proportions in the control group were uniformly higher, but the difference was not statistically significant. The prevalence of smokers was highest at age 21 and declined slightly thereafter.

These results, obtained with individuals as the analytic unit, may overestimate significance levels owing to clustering effects. When the mean for each school population is taken as the analytic unit, however, the preventive effect in the four intervention groups vs the two control groups remains significant in baseline nonsmokers. The prevalence of all smokers was 28%, 30%, 30%, and 32% in the four intervention schools and 36% and 46% in the control schools. The mean prevalence of all smokers was 30% and 41% in the intervention and control schools, respectively ($F = 11.7$, $P = .027$). The mean prevalence of those who reported smoking at least once a month was 28% and 35%, respectively ($F = 8.35$, $P = .045$). The school prevalence was 24%, 27%, 25%, and 30% for intervention schools and 32% and 38% for control schools.

After 15 years, cumulative exposure to tobacco was 22% lower in the intervention groups than in the control groups ($P = .017$) if missing data points were replaced; 25% lower ($P = .014$) if missing data points were ignored; and 27% lower ($P = .050$) if only data for subjects who participated in all surveys were used in the analyses. The preventive effect measured by lifetime tobacco consumption (Figure 1) was slightly more pronounced among men than among women (27% lower in men and 24% lower in women), although the interaction between intervention group and sex was statistically not significant ($P = .244$). Men tended to smoke more heavily than women. The average man in the intervention group had consumed 5500 fewer cigarettes than his counterpart in the control group between the ages of 13 and 28.

Discussion

These findings provide promising evidence that theory-based prevention programs can reduce lifetime tobacco exposure among young people. An additional and unique result is that the effects were observed far into adulthood. It is important to note that these results were obtained in an area where school-based prevention activity was combined with an intensive



Note. Analyses of variance: school group, $P = .027$; sex, $P < .000$; school and sex interaction, $P = .28$. The intervention program ran from 1978 through 1980, and students were followed up until 1993. A total of 640 subjects (71% of the original cohort) participated in the final survey.

FIGURE 1—Cumulative lifetime cigarette smoking, in packs, among male and female students in intervention and control schools: North Karelia Youth Program.

community-level anti-smoking campaign for adults. Similar findings have been reported for the Minnesota Heart Health Program, which also had community- and school-based components.[11] Flynn and coworkers reported[13] that a school-based smoking prevention program combined with an intensive mass media component may also have a long-term positive effect, lasting at least 2 years after the program.[13]

Although a recent report on the Life Skills Training Program[12] seems to indicate that a very intensive school program alone may have long-term effects, such effects have not been reported with less intensive school-based activities.[7–9] Other North Karelia data suggest that this preventive effect is limited to the schools and age groups that participated in the school program.[21] In the Stanford Five-City Project, likewise, a program aimed at adults was found to have no effect on smoking among youths.[22] These findings suggest that school-based prevention campaigns should be combined with both communitywide cessation campaigns for adults and a strong mass media component.

It is somewhat surprising that the health educator–led program did not have stronger effects than the teacher-led program after the immediate posttest. This finding may be a result of the communitywide program to which both sets of program schools were exposed. The number of schools was too small to permit firm conclusions about the level of effectiveness of the two programs. However, the results suggest that these programs may also be effective in normal school settings.

By the time the subjects were 28 years old, the advantage of the intervention schools was reduced and was no longer statistically significant. The reduction followed mainly from a decline in smoking, which was greater in the control than in the intervention groups. However, a preventive effect was seen among those who were nonsmokers at the outset. This result raises the possibility that greater effects could be achieved if preventive programs were begun before children were likely to take up smoking. With very long follow-up, lifetime exposure to smoking starts to become a more important measure of outcome than the actual prevalence of smokers. The statistical power in this study is insufficient for separate analyses of males and females. However, the consistency of the pattern of preventive effect measured either by lifetime exposure or by smoking prevalence in successive follow-up surveys suggests that the program may be more effective among males than among females. Similar findings have surfaced from the Oslo Youth Study in Norway.[9]

From a statistical point of view, the most appropriate unit for analysis is the selection unit for assignment to intervention and control groups. In school programs this is feasible. In our study there was surprisingly little difference in the results whether the unit was a school or a student, despite the fact that we had only six schools in our study. The schools selected for the program were typical of schools in eastern Finland. About 60% of the Finnish people live in urban areas. The differences within the country are relatively small. Hence, it is likely that these schools represent normal and typical Finnish schools.

This study provides evidence that the effect of a school-based smoking prevention program can last for several years,

especially if the program is simultaneously associated with a community-based smoking cessation program for adults. □

References

1. Thomson EL. Smoking education programs 1960–1976. *Am J Public Health*. 1978;68: 250–255.
2. McAlister A, Perry C, Maccoby N, et al. Pilot study of smoking, alcohol and drug abuse prevention. *Am J Public Health*. 1980;70:719–721.
3. Flay BR. Psychosocial approaches to smoking prevention: a review of findings. *Health Psychol*. 1985;4:449–488.
4. Bruvold WH. A meta-analysis of adolescent smoking prevention programs. *Am J Public Health*. 1993;83:872–880.
5. Vartiainen E, Tossavainen K, Koskela K, Korhonen HJ. Smoking prevention in youth. In: Filer LJ Jr, Lauer RM, Luepker RV, eds. *Prevention of Atherosclerosis and Hypertension Beginning in Youth*. Philadelphia, Pa: Lea & Febiger; 1994.
6. Glynn TJ. Essential elements of school-based smoking prevention programs. *J Sch Health*. 1989;59:181–188.
7. Flay BR, Koepke D, Thomson SJ, Santi S, Best A, Brown KS. Six-year follow-up of the first Waterloo school smoking prevention trial. *Am J Public Health*. 1989;79:1371–1376.
8. Murray DM, Pirie P, Luepker RV, Pallonen U. Five-and six-year follow-up results from four seventh-grade smoking prevention strategies. *J Behav Med*. 1989;12:207–218.
9. Klepp K-l, Øygard L, Tell GS, Vellar OD. Twelve-year follow-up of a school-based health education programme. The Oslo Youth Study. *Eur J Public Health*. 1994;4:195–200.
10. Ellickson PL, Bell RM, McGuigan K. Preventing adolescent drug use: long-term results of a junior high school program. *Am J Public Health*. 1993;83:856–861.
11. Perry CL, Kelder SH, Murray DM, Klepp K-l. Community-wide smoking prevention: long-term outcomes of the Minnesota Heart Health Program and the Class of 1989 Study. *Am J Public Health*. 1992;82:1210–1216.
12. Botvin GJ, Baker E, Dusenbury L, Botvin E, Diaz T. Long-term follow-up results of a randomized drug abuse prevention trial in a white middle-class population. *JAMA*. 1995;273:1106–1112.
13. Flynn BS, Worden JK, Secker-Walker RH, et al. Mass media and school interventions for cigarette smoking prevention: effects 2 years after completion. *Am J Public Health*. 1994;84:1148–1150.
14. Puska P, Vartiainen E, Pallonen U, et al. The North Karelia Youth Project: evaluation of two years' intervention on health behaviour and CVD risk factors among 13- to 15-year-old children. *Prev Med*. 1982;11:550–570.
15. Vartiainen E, Pallonen U, McAlister A, Koskela K, Puska P. Effect of two years educational intervention on adolescent smoking: the North Karelia Youth Project. *WHO Bull*. 1983;61:529–532.
16. Vartiainen E, Pallonen U, McAlister A, Koskela K, Puska P. Four-year follow-up results of the smoking prevention program in the North Karelia Youth Project. *Prev Med*. 1986;15:692–698.
17. Vartiainen E, Pallonen U, McAlister A, Puska P. Eight-year follow-up results of an adolescent smoking prevention program: the North Karelia Youth Project. *Am J Public Health*. 1990;80:1:78–79.
18. Pallonen U, Vartiainen E, Pöyhiä P, Luukkainen A-L, Koskela K, Puska P. *The North Karelia Youth Project Description and Feasibility of the Intervention*. Helsinki, Finland: National Public Health Institute; 1982. Publication B2/1982.
19. Puska P, Tuomilehto J, Nissinen A, Vartiainen E, eds. *The North Karelia Project. 20-Year Results and Experiences*. Helsinki, Finland: National Public Health Institute; 1995.
20. Vartiainen E, Puska P, Jousilahti P, Korhonen HJ, Tuomilehto J, Nissinen A. Twenty-year trends in coronary risk factors in North Karelia and in other areas of Finland. *Int J Epidemiol*. 1994;23:495–504.
21. Vartiainen E, Tossavainen K, Viri L, Niskanen E, Puska P. The North Karelia Youth Programs. In: Hyperlipidaemia in childhood and the development of atherosclerosis. *Ann NY Acad Sci*. 1991;623:332–349.
22. Winkleby MA, Fortmann SP, Rockhill B. Cigarette smoking trends in adolescents and young adults: the Stanford Five-City Project. *Prev Med*. 1993;22:325–334.